Original Article

Using metadata to support DRM, trading and administration of globally deployed digital products

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ABSTRACT There is growing need by owners, developers and consumers of digital products for a metadata platform to create commercial application and content profiles of digital products for the purposes of digital rights management (DRM) and digital product trading. To meet this demand a metadata-based digital management platform is needed to support both the production and consumption life cycles of digital products. This involves the creation, definition, use and relevant reporting of metadata for the control and administration of 'point-of-use'-based DRM, as well as the associated legal and commercial requirements of such a service. Developing and implementing a metadata digital management platform must be based on a global infrastructure and the needs of Intellectual Property Rights governance over digital products. In all sectors, a metadata-based digital management platform is required to adequately deal with and provide for security, authentication, identification, permissions, data storage, metadata ownership, digital products ownership and liability responsibility, business models, legislation, taxation, sovereignty, interoperability, multilingual interfaces, transaction types, biometrics, continuity of service, off-line functionality, licensing models, pricing models, application metrics for technical support and e-commerce.

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INTRODUCTION

Metadata, IPR and DRM

Intellectual Property Rights (IPR) are the foundation for measuring and protecting the utility of digital products, and, hence, value accumulation. They are necessary to support and justify investment in the digital economy.

As more and more business processes and knowledge are transferred to the digital environment, the nature of the participants, their activities, tools, resources and associated dynamics change profoundly. Previous management practices and tools are no longer sufficient to support value creation and maintenance in this

new environment. Hence, it is imperative that new tools, new thinking and new ways to measure, control and administer these products, activities, processes and participants are developed.

To meet this challenge, the development of a new metadata-based digital product management platform is required. This platform must aim to achieve real-time global management and administration of digital products serving the needs of property owners and users, while being consistent with commercial deployment and procurement processes. The ability of owners to manage the deployment of their digital products, and, equally, for consumers to evaluate their

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expenditure in real-time, is essential for the survival and evolution of commercial enterprises in an increasingly highly connected economy.

IPR governance

IPR governance is the process of identifying specific digital objects and setting terms of use and access. These terms and conditions must then be enforced by another process, commonly known as digital rights management (DRM). Traditional DRM has centered on technical enforcement of these ownership rights, but is largely considered to have failed, giving rise to growing consumer disquiet. This is mainly because of poor communication between consumers and the digital product's rights owners. Illegal use of digital products is, therefore, unmeasured and consequently ungovernable.

The only avenue currently available to owners when faced with failure of DRM technology and theft of their digital property is recourse to the courts, an avenue only open to corporations with very large financial resources. However, such a remedy has been of limited success, as evidenced by the consumer backlash in the music and entertainment industries.

Using dynamic metadata-based information to achieve 'active' DRM for IPR governance is the way of the future. Doing so will provide information vital to securing ownership and measuring the value of digital products. New, more efficient business models and sales channels will be made possible. Creative and innovative products will find quicker and cheaper roads to market. Separate systems for managing the different needs of data and metadata introduce dynamics and efficiencies not possible by traditional *ad hoc* co-mingling of data and metadata on common infrastructures and business processes.

Metadata and global commercial deployment of digital products

The development by the Dublin Core Metadata Initiative of application-profiling¹ saw the beginning of the use of metadata in the document management and content publication industries. It has traditionally been focused on standardizing terms and naming conventions of metadata items deemed necessary to provide for efficient use and administrative control over

digital products, primarily in the field of library science. Its objectives are, therefore, to support the needs of content publication, transmission, storage, retrieval, copyright and attribution.

Similar needs for administering the output of developers have been growing in other areas of software applications and content. Traditional solutions for digital product owners of license management and/or subscription-based access have resulted in high levels of illegal use of digital products.² Inadequate communication between users and owners creates the differing perceptions of value at the center of this problem.

The scale of the IPR governance problem grows as the Internet expands and connectivity increases, creating an increasing demand for effective real-time digital management of IPR by both creators and consumers of digital products.

The underlying concepts of digital management are as follows:

- Identification (owners, products, users and rights);
- Custody (enforcement of rights);
- Measurement (evidence of enforcement of rights); and
- Settlement (transfer of value).

A digital management service platform using metadata in the above conceptual framework will enable owners, in accordance with a legal contract with consumers, to set and enforce all terms and conditions necessary for effective IPR governance over deployed digital products.

The implementation of digital management services on a global scale is fundamental to the future development of the digital economy.

Digital products

An identifiable digital object, content or application is commonly referred to as a digital product. The ability to measure the use of a digital product requires that it be uniquely identified to be of relevance to any metadata schema. A digital product must rely on the uniqueness of identification against a set of characteristics of a product, rather than on an individual instance of the product, because of the ease with which digital products can be replicated. That is to say, users generally do not

get to own digital products in the same way consumers of physical goods get to own their consumption, for example an owner of a car.

The limited exception is the case of open-source licencing, in contrast to proprietary software licenses: ownership of a particular copy of the software does not remain with the software publisher. Instead, ownership of the copy is transferred to the end-user. As a result, the end-user is, by default, afforded all rights granted by copyright law to the copy owner. Note that 'copy owner' is not the same as 'copyright owner,' as ownership of a particular copy is transferred, whereas ownership of the copyright remains with the software publisher. Additionally, open-source software licenses typically grant to the end-user extra rights, which would otherwise be reserved by the software publisher.³

The costless replication nature of digital products makes it vital to proper IPR governance that digital management of digital products occurs at their point-of-use. Further, digital management of common ownership over different digital products is possible only through a system where ownership characteristics can be associated with different digital objects, which together achieve a unique identity required for control.

Obviously, the less metadata applied to the management of a digital product, the less information is available about the use of the product. Similarly, the more specifically the needs of a digital product can be connected to its utility metrics, the more fine-grained the management of control and reporting on that product.

Owners and consumers

Individuals or enterprises having claims to identifiable digital products through creation or purchase will always need to protect their property to justify their investment. Investments are justified in many ways, most commonly by measuring income derived through distribution or consumption. Therefore, an essential element of IPR governance must be the ability to measure the use of digital products by authorized users. In a dynamic control environment as envisaged by metadata-driven digital management, a user not complying with terms and conditions must be capable of being

prevented from using digital products both before and after access has occurred.

The use of metadata-based digital management cannot have a negative impact on available distribution channels of digital products if it is to have any chance of being implemented, that is, it must support traditional sales models in addition to the new.

These new avenues to the customer made available by the use of digital management will have a significant positive impact on digital product sales by supporting (1) commercial deployment of digital products in peer-to-peer networks, (2) post-deployment changes in terms of use (SaaS – Software as a Service) and (3) PAYU (Pay As You Use) access to digital products.

Users have rights over their access and use of digital products. These rights originate from their agreements made with the digital product owner, from common law and from consumer protection legislation. These rights can be better guarded and the utility of the user experience enhanced by metadata-based digital management services. Dissatisfaction arising from bad consumer experiences can be minimized by better communication and information provided by digital management. Extending available metadata, to include error log and performance metrics for dynamic technical and customer support digital management, will also provide real-time customer relations and technical support services.

Digital management providers and metadata ownership

Metadata used to manage and control the use of digital property is created by a digital management platform. Initial ownership of this metadata is assumed to lie with the digital management system provider unless case law states otherwise.

Access by owners and users to metadata as part of their own business processes could be supported by the digital management service provider by making the relevant metadata available to their customers' internal systems, separate from the digital management system.

The ownership of metadata may prove to be a problem where metadata is created and collected by third parties for content owners, and it is required that data privacy issues are

managed properly. These problems can be avoided by good business practice requiring that service-level agreements, covering all these issues, are agreed upon and documented whenever digital management services are implemented.

The European Commission's INFO 2000 Programme Index Report⁴ identifies the four following guiding principles of any metadata framework for supporting effective ecommerce:

- *Unique Identification*: every entity should be uniquely identified within a unique namespace;
- *Functional Granularity*: it should be possible to identify an entity whenever it needs to be distinguished;
- *Designated Authority*: the author of an item of metadata should be securely identified; and
- *Appropriate Access*: everyone requires access to the metadata on which they depend, as well as privacy and confidentiality of their own metadata from those who are not dependent on it.

Financial transactions

Use of metadata to control and measure use of digital objects in real-time gives rise to financial transactions and settlement of obligations between owners and users in real-time. The use of metadata enables far more sophisticated financial engineering of digital product selling and pricing models. Examples of this could be a real-time co-joining of products from different owners to provide a unique solution to a user, use of micro-payments to reduce the costs of electronic health-care services to third-world consumers, service contracts for PAYU or prepaid access to digital products, or even digital product-use billing via telephone or utilities providers.

METADATA DRM IMPLEMENTATION

Foundations of metadata-based digital management

Current metadata taxonomies reflect two-way- or single-dimension relationships among digital products, users and owners. The dynamic nature of metadata-based management in a connected world requires a more encompassing view of the relationships that interact.

Figure 1: Dynamic commercial metadata flows.

Owners and users of digital products must be identified in system-registered Namespaces or Domains (see Figure 1). Namespaces or Domains need only differ in that owners have 'product-use' rights and 'product-sales' rights, and users have 'product-use' rights. 'Product-sales' rights need to allow the owners to create metadata-identifying products to which they apply contracts. 'Product-use' rights need to allow acceptance of these contracts. These contracts would outline the terms and conditions under which registered users on the system could use the digital product.

Product interaction and metadata can only be effective using very secure, three-party communications among users, owners and digital products (see Figure 2). In addition, storage of metadata, enforcement processes and transaction transparency requires a central communication point with metadata storage managed by a trusted arbiter, mediator and transaction broker.

Metadata-based digital management requires a paradigm shift in understanding the differences in control exhibited over traditionally unmanaged products and control over metadata-managed products.

The fundamental basis of the digital management process is the creation of Internet-product avatars that represent the digital products to be controlled (see Figure 3). These product avatars are given ownership and control attributes that define their behavior subject to instructions. The product avatar must be able to have a degree of secure communication with the digital product being controlled in order to effect these instructions. The controlled digital product will therefore have had Application Programming Interface (API) calls embedded

Figure 2: Authoritative metadata communications.

Figure 3: Metadata setup and administration.

Figure 4: Metadata APIs integrated in digital object.

Figure 5: Digital management operational processes.

within it, or will be wrapped with a communicating layer, which has the effect of making the digital product non-functional unless specific permissions are received from its product avatar (see Figure 4).

Traditional unmanaged digital products are usually deployed fully functional, with access denied by license management technology based around encryption and decryption processes. These technologies rely on static attributes being applied pre-deployment to allow execution of the product after deployment upon receipt of appropriate license keys. Generally, once an unmanaged digital product has been deployed, its access attributes cannot be changed. When such a digital product is sent to many parties along with its license keys, there is no way for a digital product owner to control or administer access beyond relying on trust relationships.

In contrast, metadata-managed products are controlled in real-time after deployment, with access and function attributes able to be changed at any time.

Implementation of metadata-based digital management

Implementation of digital management requires analysis of the metadata essential to meet the business needs of relevant digital products. Detailed value and support metrics for micro-payment, and/or modular access and other support, requires very detailed analysis, and results in proportionately more metadata being created both on implementation and in operation. In contrast, simple on-off control requires next to no analysis, and results in minimal metadata creation or use, other than authentication messages and initiation and cessation instructions.

A digital management system's ability to identify and control the legal rights of a user to access and enforce terms, and to measure activity, is determined by the amount and type of metadata generated from embedded APIs in the source code or digital management wrapper of a product. APIs embedded in digital product initiates calls out to the DM Agents that are required to provide access and permissions information in order to execute and remain operational. This allows the digital product to be distributed freely without fear of illegal use (see Figure 4).

Complex utility and support metrics are able to be supported by relevant digital management APIs being added to the source code of the product. These APIs cause the product to interact with metadata for permissions, and to communicate events for measurement and control. The more complex the management requirement of a digital product, the more APIs will be embedded, and, hence, the more metadata is created and used.

Digital products can thus be distributed through different channels than those of the access to them. This effectively separates the problem of growing an installed userbase from that of selling the value of the product. Effectively used digital products that were digitally managed could be made available for free, but access or use thereof could be subject to a multiplicity of sales channels (see Figure 5).

Metadata and security

Metadata is the data that describe the relevant contextual information consisting of the

identification of the digital object, its owner and all the terms and conditions created to measure use, users and utility by digital management services.

The ability of metadata to securely control products is largely dependent on securing the metadata communication channels and storage repositories. This can be achieved by using the Internet's standard Secure Socket Layer, Public Private Key and Certificate Authentication processes between transaction parties and the products, and by using A-Class Data Centers to centrally store metadata.

The degree to which security layers are implemented in and over any digital management product is determined by the product's intrinsic value and the value degradation time curve of the information value requiring protection. In other words, relatively inexpensive software applications and content the value of which comprises information of a very time-sensitive nature require relatively little security to be implemented. Alternatively, highly valuable systems software or content of a long-term value would benefit from a high investment in security.

Technology infrastructure

Any infrastructure supporting digital management services will include the following:

- no single points of failure, such that loss of Internet connectivity will not interrupt digital management services or prevent users from accessing digital assets or products to which they are entitled;
- universal availability of control over digital management and administrative settings, and reporting tools via the Internet;
- integration of application usage information with Enterprise Resource Planning/accounting, billing and payment systems; and
- little or no infrastructure impositions on existing information and communication technology environments.

Infrastructure supporting digitally managed products needs to effectively serve standalone PCs, Small Office Home Offices and enterprise networks without compromising security or disabling offline control (see Figure 6).

Figure 6: Authoritative metadata engine infrastructure architecture.

THE METADATA-CENTRIC BUSINESS MODEL

Digital management

Digital management creates value in two main ways. First, it creates the possibility to transaction-snip, or, in other words, charge a percentage fee, or share in the revenue between owners and users of digital products. Secondly, it can build a large userbase very quickly. Large userbases create significant capital value for any business. Other opportunities deriving revenue from userbases for business value arise from opportunities for the sale of advertising, market intelligence and metadata services for provisioning and procurement. This will extend aggregation services, which currently only deal with content and data, to products from different vendors comprising solution sets of different expert systems products combined and customized to suit specific enterprise environments.

Digital management- and metadata-centric services will become significant business activities in the near future, with major impacts on how business processes are organized. For example, metadata services will develop to link Geographical Information Systems-based control of transport and enable consumers to create and manage self-governing transport services, where vehicles used by multiple users are administered and managed via digital management services. Another example might be the building of virtual processing plants using supplier data to integrate and enable real-time supply of construction and maintenance material and parts to plant owners. Savings worth many billions of dollars are possible, but this cannot be done

Figure 7: Commercial metadata-profiling business space.

while supplier data remains unmanaged in the digital environment.

Effectively, digital management is the framework of functionality that links producers and consumers of digital products in a legal auditable system providing security of ownership, measurement of value and flexibility to better support commercial activities (see Figure 7).

By using metadata profiles via digital management services to manage products in production and consumption lifecycles, the needs of both parties can be met far more efficiently than is currently the case.

Regulators, taxation, legal obligations and liabilities

Access to a digital product can only be denied where the digital product is subject to enforcement of legal rights. These rights are recognized by law in the form of contracts, copyright, trademarks and patents. In the instance of a digital product being subject to a right of ownership, no user can demand use of the product without referring to an agreement where such rights have been extended to include the intended user by a digital management system.

The communication of legal intent, transmission and storage of value, and evidence thereof, is also subject to regulation and legal sanctions. The sources of this regulation come from corporate, financial, communication and consumer protection legislation. Legal sanction is required to show authentication, and evidence of agreements and compliance between relevant parties. Digital management services meet the needs of regulators and legal obligations in the electronic connected economy.

Further, there is a growing urgency from Governments to find effective ways to enclose the digital economy within the fiscal walls of sovereign regimes in order to bring the associated economic activity into their taxation orbits. These needs of Governments to measure economic activity and tax transactions within the digital economy can only be effectively met by broadly deployed digital management services. When this is realized, one can confidently predict that digital management services will be made compulsory for businesses operating in the digital economy.

In summary, the speed and extent of the Internet has overtaken the ability of traditional law and government institutions to administer legal requirements of a connected environment in a timely and efficient manner. For these reasons, a broad uptake of digital management services can be realistically expected to occur in the near future, in order to electronically facilitate government administration of tax and legislation, and meet the legal and commercial needs of the digital economy.

CONCLUSION

The use of metadata for commercial deployment and consumption of digital products will dramatically change the nature of digital product procurement and provisioning of enterprises and individuals.

The future of the traditional software industry in the digital economy, previously based largely around boxed software products, the enterprise software industry of big deals, and concentrated corporate and local computing, is changing. The next generation of digital product value builders is going to be serviced-based and metadata-managed. Even hardware value will become dependent on the services that it

supports, and will be subject to metadata management.

The move to controlling digital product by metadata, trading digital products and management at point-of-use, is inevitable. The technology to support point-of-use metadata control and to administer IPR metadata already exists.⁵ The market is increasingly demanding change. Software on Demand, SaaS and PAYU are terms and concepts that were largely unknown a year or two ago, but are now common in the digital product marketplace.

Metadata management of digital property will become the 'Digital Land Titles Administration' aspect of the cyber-world. It will enable proper ownership of digital property, and will support efficient and effective business metrics required to account for 'digital rent' that underpins the accumulation of ultimate digital capital.

Ultimately, economic value is about measurement that can only be achieved by effective metadata-based management of digital products.

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